Medical Gas Recirculation System

The present invention relates to an apparatus and method for recirculating at least a binary gas mixture to a medical device such as a cardiac pulmonary bypass oxygenator or an artificial ventilator.

More particularly the invention relates to an apparatus and method for controlling the composition, pressure and flow rate of a recirculating gaseous composition to a medical device, particularly to a cardiopulmonary bypass oxygenator, and recycling the gaseous composition.

Medical devices such as cardiopulmonary bypass oxygenators and artificial ventilators or respirators require a reliable and constant source of gas for safe and reliable operation for use during the relevant medical procedures.

Usually, the gaseous compositions used for procedures with such devices are various air/oxygen or nitrogen/oxygen mixtures, although in some situations, these devices may be used for administering other active agents to a patient.

For example, it is common to use a respirator for administering an anaesthetic agent to anaesthetise a patient prior to undergoing certain surgical procedures. Xenon is known for use as an anaesthetic agent.

US-A-4989597 (Werner) discloses an apparatus for administration of at least two gases, particularly oxygen and xenon, to a patient via a respiration apparatus comprising a patient circuit and a drive circuit. The patient circuit, which enables rebreathing of the gas to make maximal use of valuable gases, is provided with fresh gas input to replace exhaled carbon dioxide with oxygen and to supplement the xenon concentration. The drive circuit and the patient circuit are in open communication and the concentration of each of the components in the patient circuit is independently monitored and controlled by addition of small quantities of one or other of the gases. The open communication between the

patient circuit and the drive circuit results in an inherent equilibrium which it is stated allows the relative concentration of gases in the patient circuit to be more controllable. Xenon eventually accumulates in the drive circuit and can be recovered therefrom by supply to a recovery bottle once a certain concentration has been reached.

More recently, xenon has been identified as being useful in the treatment of neurointoxications, for example in WO-A-0053192. In particular, it is stated that xenon can reduce the release of neurotransmitters, particularly dopamine, which is caused by, for example, hypoxic situations such as an apoplexy or a craniocerebral trauma. It is stated (on page 5, lines 15-18 of WO-A-0053192) that use of the cardiopulmonary bypass machine can cause an unidentified neurointoxication, which significantly delays a patient's reconvalescence. According to WO-A-0053192, xenon may be administered by an inhalation method, or alternatively, may be added directly to a cardiopulmonary bypass machine. Further, WO-A-0108692 discloses the use of xenon as an NMDA antagonist to, for example, provide neuroprotection, relieve neuropathic pain or inhibit synaptic plasticity.

Under normal circumstances, cardiopulmonary bypass oxygenators are supplied with an oxygen/air or oxygen/nitrogen mixture on a once-through basis after which the spent gas (comprising the remaining oxygen, nitrogen and carbon dioxide flushed from the patient's blood) is vented to atmosphere. However, the use of xenon, or any other high value gas, in a cardiopulmonary bypass oxygenator would make this a very expensive procedure.

An apparatus and method for providing and recirculating gas to a medical device, such as a cardiopulmonary bypass oxygenator or an artificial ventilator, which also enables recovery of the high value gas is highly desirable, particularly when applied to a medical device used in an environment where space is at a premium.